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Indian Standard

METHODS FOR TESTING JUTE CORDAGES FOR RESISTANCE TO ATTACK BY MICRO-ORGANISMS

(*First Revision*)

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INDIAN STANDARDS INSTITUTION
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Indian Standard
METHODS FOR TESTING JUTE CORDAGES FOR RESISTANCE TO ATTACK BY MICRO-ORGANISMS
(First Revision)

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(*Continued on page* 2)

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Indian Standard

METHODS FOR TESTING JUTE CORDAGES FOR RESISTANCE TO ATTACK BY MICRO-ORGANISMS

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 9 July 1979, after the draft finalized by the Chemical Methods of Test Sectional Committee had been approved by the Textile Division Council.

0.2 This standard was first published in 1960 and has been revised to make it up-to-date on the basis of the experience gained during its use. Jute cordages are liable to deterioration by micro-organisms. Since they are often stored, transported and used under conditions favourable for the growth of micro-organisms, various preservative treatments have been developed and their number is constantly increasing and hence, the need for standard methods for testing resistance of the cordage to attack by micro-organisms.

0.3 Two methods are prescribed in this standard, namely: (a) Mixed culture inoculation method, and (b) Soil incubation method. In the first method, a mixture of spores of five different fungi, which are frequently the cause of deterioration of jute cordages, is used. In the second method, the cordage is subjected to the action of a much greater variety of micro-organisms, both fungi and bacteria, normally found in the soil. The first method serves to assess the behaviour of jute cordages under exposure to humid and warm atmosphere whereas the second method serves to assess their behaviour under conditions of contact or contamination with soil. Since, often a combination of the above two conditions exists in practice in relation to the use of the cordages, the assessment is based on testing by both the methods.

0.4 Cultures of the organisms prescribed in this standard for the test can be obtained from the Indian Jute Industries' Research Association

(IJIRA), 17 Taratola Road, Calcutta 700053. To facilitate supply, the culture numbers, as set out below should be mentioned:

Species	IJIRA Culture No.
Chaetomium indicum Corda	75
Curvularia lunata (Wakker) Boedijn	10
Aspergillus fumigatus Fresenius (*see* Note)	14
Penicillium rubrum Stoll	127
Penicillium wortmanni Klocker	130·64

NOTE — *Aspergillus fumigatus* Fresenius has been found to cause infection of lungs and of external ear in human beings. Great care should, therefore, be taken in handling the organism not to inhale the spore dust from the culture tube when preparing the mixed spore suspension (*see* Appendix B).

0.5 The methods prescribed in this standard can also be used for evaluating preservatives or treatments designed to protect jute cordages from damage by micro-organisms. In such cases, the preservative or treatment has to be applied to a uniformly good quality jute cordage by the procedure recommended by the supplier or the originator and the treated cordage then tested.

0.6 In reporting the result of a test made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

1. SCOPE

1.1 This standard prescribes two methods for evaluating jute cordages for resistance to attack by micro-organisms.

2. ATMOSPHERIC CONDITIONS FOR CONDITIONING AND TESTING

2.1 The tests shall be carried out under the conditions laid down in respective test procedures. However, the specimens for breaking load testing shall be conditioned and tested in the standard atmosphere of 65 ± 2 percent relative humidity and 27 ± 2°C temperature (*see also* IS : 6359-1971†).

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*Rules for rounding off numerical values (*revised*).

†Method for conditioning of textiles.

2.2 When the specimens have been left in such an atmosphere for 24 hours in such a way as to expose, as far as possible, all portions of the specimens to the atmosphere, they shall be deemed to have reached moisture equilibrium.

3. SAMPLING

3.1 Samples shall be drawn so as to be representative of the lot. Samples drawn in accordance with the procedures laid down in material specification or as agreed to between the buyer and the seller shall be taken as representative of the lot.

3.2 From the selected samples of cordage, take a piece or pieces at least 1 500 cm in length. Cut at random 36 pieces of 25 cm length. Separate them into two sets of 18 pieces each. Mark one set to be identified as *test specimens* (*see* Note).

NOTE — The ends of each specimen should be tied up before carrying out the test. If the specimen is drawn from a strand, it should be given a slight twist so as to bring it back to the original condition and the ends then tied up.

3.2.1 Take the other set of 18 specimens. Coil each specimen in the form of a loose spiral and leach the specimens, one by one, according to the method given in Appendix A. Dry them in air. Mark each specimen to be identified as *leached test specimens* (*see* Note under **3.2**).

3.3 From the basic untreated cordage (*see* Note) take a piece of at least 500 cm in length. Cut at random a set of eighteen specimens 25 cm long and mark them to be identified as *control specimens.*

NOTE — If an authentic sample of the basic cordage is not available, a cordage similar in construction to the one under test should be used.

4. MIXED CULTURE INOCULATION METHOD

4.1 Apparatus

4.1.1 *Small Petri Dishes* — 9, each 10 cm in diameter and without cover.

4.1.2 *Large Petri Dishes* — 9, each 15 cm in diameter and 3 cm high provided with cover.

4.1.3 *Atomizer* — of 10 ml capacity.

4.2 Test Organisms — For the purpose of this test, the following test organisms shall be used:

a) *Chaetomium indicum* Corda,
b) *Curvularia lunata* (Wakker) Boedijn,
c) *Aspergillus fumigatus* Fresenius,
d) *Penicillium rubrum* Stoll, and
e) *Penicillium wortmanni* Klocker.

4.3 Procedure

4.3.1 Draw at random six test specimens (*see* **3.2**). Condition them to moisture equilibrium in standard atmosphere and determine the breaking strength of each individual specimen in a vertical or horizontal type strength testing machine keeping the distance between the grips of the machine at 12·5 cm. Find the average of all the values.

4.3.2 Draw at random six control specimens (*see* **3.3**). Condition them to moisture equilibrium in standard atmosphere and determine the breaking strength of each individual specimen in a vertical or horizontal type testing machine keeping the distance between the grips of the machine at 12·5 cm. Find the average of all the values.

4.3.3 From the leached test sample, draw at random six specimens, condition them to moisture equilibrium in standard atmosphere and determine the breaking strength of each individual specimen in a vertical or horizontal type strength testing machine keeping the distance between the grips at 12·5 cm. Find the average of all the values.

4.3.4 Prepare, in the manner prescribed in Appendix B, a mixed suspension of spores of the test organisms prescribed in **4.2**.

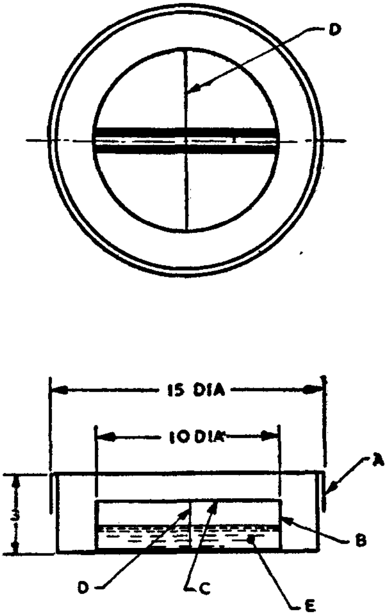
4.3.5 Draw from the test specimens (**3.2**) another set of six specimens.

4.3.6 Carefully cut off the fibres projecting from the surface of each specimen. Take a pair of specimens and fasten them by a strand of yarn drawn from one of the specimens on the small Petri dish across the middle, so that the centre of each specimen lies near the centre of the dish on its upper side (*see* Fig. 1). In a similar manner, place four specimens (in pairs) on two other small Petri dishes. Place each dish in a large Petri dish. Spray by means of an atomizer approximately 1·5 ml of the mixed spore suspension (*see* Note 1) on the pair of specimens in each small Petri dish. Place the Petri dish assemblies in an incubator until excess moisture is driven off (*see* Note 3). Finally cover each of the outer Petri dishes. Put all the Petri dish assemblies in an incubator at 30 ± 2°C for 21 days. At the end of this period, add a few drops of methyl alcohol on a small piece of cotton wool and place it in each of the outer dishes and allow them to rest for two hours outside the incubator. Condition the specimens to moisture equilibrium in standard atmosphere and determine the breaking strength of each individual specimen in a vertical or horizontal type strength testing machine keeping the distance between the grips of the machine at 12·5 cm. Find the average of all the values.

NOTE 1 — Sterilization of the specimens is not necessary as it has been found that when density of the mixed spore suspension is as high as has been prescribed for this test, both sterilized and unsterilized specimens yield nearly similar results.

NOTE 2 — Allowing the specimens to stand overnight at 30°C would drive off excess moisture.

NOTE 3 — Wetting of the specimens should be avoided. The supporting thread prevents their sagging and if the fibres projecting laterally from the surface have been cut off carefully, the specimens should not get wet.



A — Large petri dish
B — Small petri dish
C — Specimen
D — Supporting thread
E — Water

All dimensions in centimetres.

FIG. 1 PETRI DISH ASSEMBLY

4.3.7 Draw six leached test specimens from the leached test sample (*see* **3.2.1**) and test them in the manner prescribed in **4.3.6**.

4.3.8 Draw six control specimens from the control sample (*see* **3.3**) and test them in the manner prescribed in **4.3.6** (*see* Note).

NOTE — If the control specimens are not covered with profuse visible growth of micro-organisms, the test shall be repeated.

4.3.9 Calculate the loss in strength, percent, of the basis cordage *on incubation* by the following formula:

$$L = \frac{100\ (a - b)}{a}$$

where

L = loss in strength, percent, of the basic cordage on incubation;

a = breaking strength value obtained as in **4.3.2**; and

b = breaking strength value obtained as in **4.3.8**.

NOTE — The value of L should be 60 percent or more. If this value is less than 60 percent, the test shall be repeated.

4.3.10 Calculate in the manner prescribed in **4.3.9**, the loss in strength, percent, of the cordage under test, *on incubation prior to leaching*,

where

a = breaking strength value obtained as in **4.3.1**, and

b = breaking strength value obtained as in **4.3.6**.

NOTE — The value of L should not be more than 20 percent. The cordage should be considered satisfactorily resistant to attack by micro-organisms, if the value of L does not exceed 20 percent.

4.3.11 Calculate in the manner prescribed in **4.3.9**, the loss in strength, percent, of the cordage under test, *on incubation after leaching*,

where

a = breaking strength value obtained as in **4.3.3**, and

b = breaking strength value obtained as in **4.3.7**.

NOTE — The value of L should not be more than 20 percent. The cordage should be considered satisfactorily resistant to attack by micro-organisms if the value of L does not exceed 20 percent.

5. SOIL INCUBATION METHOD

5.1 Apparatus

5.1.1 *Glass Jars* — round, wide mouth, flat bottomed.

5.1.2 *Petri Dishes* — as covers.

5.1.3 *Incubator* — Capable of being maintained at 30 ± 2°C and provided with trays full of water at the bottom.

5.2 Test Soil — prepared in the manner prescribed in Appendix C.

5.3 Procedure

5.3.1 Take the remaining six test specimens (*see* **3.2**).

5.3.2 Coil each specimen into a flat spiral and tie it with thread so that it does not uncoil and yet a small length of its ends is left free. Put the test soil in each of the six glass jars of suitable size and bury one coiled specimen in each jar so that the specimen is in a horizontal plane and is covered on all sides (except the free ends) with test soil. The soil inside the jars should cover about three-fourth of its height and the samples should be about 5 to 6 cm below the soil surface. Close the jars with Petri dishes and keep them in the incubator at 30 ± 2°C. Incubate the specimens for 21 days if size is smaller than 3·2 cm and 42 days if specimens are of bigger size. After 21 days of incubation, check the moisture of the soil and, if need be, adjust the moisture to 25 to 27 percent. At the end of this period, remove the specimens, wash gently to free them from soil and dry them in air (*see* Note). Condition the specimens to moisture equilibrium in standard atmosphere and determine the breaking strength of each individual specimen in a vertical or horizontal type strength testing machine, keeping the distance between the grips at 12·5 cm. Find the average of all the values.

NOTE — Exposure of test samples after washing to methyl alcohol fumes in a desiccator for 2 to 4 hours for drying gives better results.

5.3.3 Take the remaining six leached test specimens (*see* **3.2.1**) and test them in the manner prescribed in **5.3.2**.

5.3.4 Take the remaining six control test specimens (*see* **3.3**) and test them in the manner prescribed in **5.3.2**.

5.3.5 Calculate the loss in strength, percent, of the basic cordage on *soil incubation* by the following formula:

$$L = \frac{100\ (a - b)}{a}$$

where

L = loss in strength, percent, of the basic cordage on soil incubation;

a = breaking strength value obtained as in **4.3.2**; and

b = breaking strength value obtained as in **5.3.4**.

NOTE — The value of L should be 80 percent or more. If this value is less than 80 percent, the test shall be repeated.

5.3.6 Calculate in the manner prescribed in **5.3.5** the loss in strength, percent, of the cordage under test *on soil iucubation prior to leaching*,

where

a = breaking strength value obtained as in **4.3.1**, and

b = breaking strength value obtained as in **5.3.2**.

NOTE — The value of L should not be more than 20 percent. The cordage should be considered satisfactorily resistant to attack by micro-organisms if the value of L does not exceed 20 percent.

5.3.7 Calculate in the manner prescribed in **5.3.5**, the loss in strength, percent, of the cordage under test *on soil incubation after leaching*,

where

a = breaking strength value obtained as in **4.3.3**, and

b = breaking strength value obtained as in **5.3.3**.

NOTE — The value of L should not be more than 20 percent. The cordage should be considered satisfactorily resistant to attack by micro-organisms if the value of L does not exceed 20 percent.

6. REPORT

6.1 Report shall include the following:

a) Type of specimen

b) *Mixed culture inoculation method*:

  i) Loss in strength, percent, of the basic cordage *on incubation* (*see* **4.3.9**);

  ii) Loss in strength, percent, of the cordage under test, *on incubation prior leaching* (*see* **4.3.10**); and

  iii) Loss in strength, percent, of the cordage under test, *on incubation after leaching* (*see* **4.3.11**).

c) *Soil incubation method:*

  i) Loss in strength, percent, of the basic cordage *on soil incubation* (*see* **5.3.5**);

  ii) Loss in strength, percent, of the cordage under test *on soil incubation prior leaching* (*see* **5.3.6**); and

  iii) Loss in strength, percent, of the cordage under test *on soil incubation after leaching* (*see* **5.3.7**).

APPENDIX A

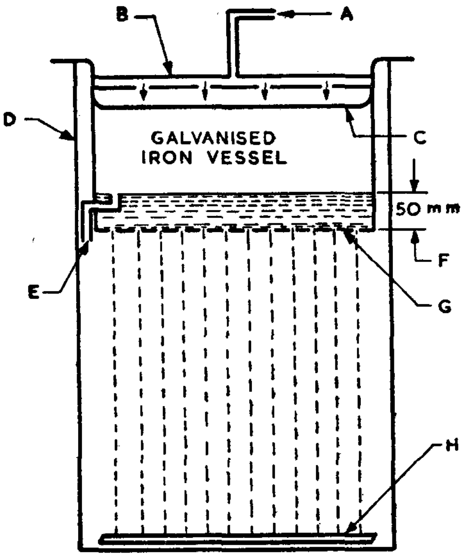
(*Clause* 3.2.1)

METHOD OF LEACHING

A-1. APPARATUS

A-1.1 Leaching Apparatus (*see* **Fig. 2**) — Consisting of a rectangular galvanized iron vessel of convenient size (*see* Note) provided with a copper bottom with perforations 0·4 mm in diameter and 20 mm apart and an automatic device to maintain the level of water inside the vessel at a height of 5 cm; the vessel being so fixed that its bottom is 30 cm above the horizontal glass base of the apparatus, which is of the same size as the perforated bottom of the vessel.

NOTE — The size of the vessel should be such as to enable the whole leaching operation to be completed within a reasonable period of time.



A — Water inlet
B — Supply tube with evenly distributed holes at the bottom
C — Baffle sheet
D — Wooden stand
E — Constant level outlet
F — Level of water
G — Perforated bottom of vessel
H — Glass base (27 × 55 cm) for holding the sample

FIG. 2 LEACHING APPARATUS

A-2. PROCEDURE

A-2.1 Place the specimen under test on the horizontal glass base. Feed tap water (*p*H 6·5 to 7·5 and temperature 30 ± 2°C) continuously for 4 hours into the vessel of the apparatus and let it fall in a shower on the specimen. Turn over the specimen after 2 hours and remove it at the end of 4 hours.

APPENDIX B

(*Clauses* 0.4 *and* 4.3.4)

PREPARATION OF MIXED SPORE SUSPENSION

B-1. REAGENTS

B-1.1 Quadruple Strength Salt Solution — prepared by mixing, in the qnantities indicated, the materials listed below:

Sodium nitrate ($NaNO_3$)	8·0 g
Potassium dihydrogen phosphate ($KH_2 PO_4$)	1·0 g
Dipotassium hydrogen phosphate ($K_2 HPO_4$)	3·0 g
Potassium chloride (KCL)	2·0 g
Magnesium sulphate ($MgSO_4 7H_2O$)	2·0 g
Distilled water	1 000 ml

NOTE — *p*H of the solution should be 7·0.

B-1.2 Jute Extract Medium — prepared as prescribed below:

Extract 10 g of jute fibres in 100 ml of distilled water for 30 minutes under reflux and filter. Take 2·5 ml of the salt solution (*see* **B-1.1**), 2·5 ml of distilled water and 5 ml of the jute extract in each of four 15 × 2 cm test tubes and insert a strip of filter paper about 2 × 7 cm so that half of it is immersed in the medium. Plug the tubes with non-absorbent cotton and sterilize them with steam in an autoclave at 0·7 kg/cm^2 pressure for 15 minutes.

B-1.3 Malt Extract Medium — prepared as prescribed below:

Mix, in the quantities indicated, the materials listed below:

Malt extract	25 g
Distilled water	1 000 ml

Put 5 ml of this solution and a strip of filter paper about 2 × 7 cm into a 15 × 2 cm test tube so that half of it is immersed in the medium. Sterilize it with steam in an autoclave at 0·7 kg/cm^2 pressure for 15 minutes.

B-2. SUB-CULTURES

B-2.0 The sub-cultures shall be prepared as prescribed in **B-2.1** and **B-2.2**.

B-2.1 Inoculate the filter paper in the tubes containing jute extract medium (*see* **B-1.2**) separately with well-sporulated cultures of the following organisms:

Chaetomium indicum Corda

Curvularia lunata (Wakker) Boedijn

Aspergillus fumigatus Fresenius

Penicillium rubrum Stoll

B-2.2 Similarly inoculate the filter paper in the tube containing malt extract medium (*see* **B-1.3**) with a well-sporulated culture of the organism *Penicillium wortmanni* Klocker. Incubate the tubes at 30 ± 2°C for 2 to 3 weeks until mature growth of the organisms is obtained.

B-2.3 The sub-cultures are now ready for use (*see* **B-3**).

B-3. PREPARATION OF MIXED SPORE SUSPENSION

B-3.1 Decant the medium from the tubes and add 6 ml of the quadruple strength salt solution to each tube. Break the perithecia of the organisms *Chaetomium indicum* Corda and *Penicillium wortmanni* Klocker by means of glass rods and shake the tubes well in order to get uniform suspension of spores. Loosen the spores of the organisms *Curvularia lunata* (Wakker) Boedijn, *Aspergillus fumigatus* Fresenius and *Penicillium rubrum* Stoll by scraping lightly with glass rod. Filter each suspension through cotton-wool to remove particles of filter paper and fungal mycelia. Take spore counts of each suspension by means of a haemacytometer and dilute the suspension of the spores of *Aspergillus fumigatus* Fresenius, *Penicillium rubrum* Stoll and *Penicillium wortmanni* Klocker with quadruple strength salt solution to the same count as that of the spores of *Chaetomium indicum* Corda or *Curvularia lunata* (Wakker) Boedijn (*see* Note) and then mix the suspensions in equal volumes.

NOTE — Suspensions of spores of the organisms *Chaetomium indicum* Corda and *Curvularia lunata* (Wakker) Boedijn give the lowest counts.

APPENDIX C

(*Clause* 5.2)

PREPARATION OF TEST SOIL

C-1. Prepare a compost by mixing thoroughly fertile garden soil, cow-dung manure and sand in the proportion of 2 : 1 : 1. Pass it through IS Sieve 340 (*see* IS : 460-1962*). Adjust its moisture content to 25 to 27 percent and test it in the manner prescribed in **C-2** to **C-4**.

C-2. Take a sufficiently long piece of hessian cloth of the following construction:

Ends/cm	4
Picks/cm	4
Mass, g/m^2	270

Draw twelve 25 × 4 cm pieces from it. Take six pieces, condition them to moisture equilibrium in standard atmosphere (*see* **3**) and determine the breaking strength of each individual piece in a horizontal or vertical type strength testing machine keeping the distance between the grips at 12·5 cm. Find the average of all the values.

C-3. Test the remaining six pieces in the manner prescribed in **5.3.2** but burying them without coiling and incubating them for 7 days only; record the average value for breaking strength.

C-4. Calculate the loss in strength of the cloth after soil burial by subtracting the breaking strength value obtained as in **C-3** from the value obtained as in **C-2** and express it as percentage loss on the value in **C-2**.

NOTE — The soil should be deemed to be suitable for test if the percentage loss in strength of the cloth after soil burial is 80 percent or more.

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*Specification for test sieves (*revised*).

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

QUANTITY	UNIT	SYMBOL
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

QUANTITY	UNIT	SYMBOL
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

QUANTITY	UNIT	SYMBOL	DEFINITION
Force	newton	N	1 N = 1 $kg.m/s^2$
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2

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22E Kalpana Area	BHUBANESHWAR 751014	5 36 27
Ahimsa Bldg, SCO 82-83, Sector 17C	CHANDIGARH 160017	2 83 20
5-8-56/57 L. N. Gupta Marg	HYDERABAD 500001	22 10 83
D-277 Todarmal Marg, Banipark	JAIPUR 302006	6 98 32
117/418 B Sarvodaya Nagar	KANPUR 208005	8 12 72
Patliputra Industrial Estate	PATNA 800013	6 28 08
Hantex Bldg (2nd Floor), Rly Station Road	TRIVANDRUM 695001	32 27

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